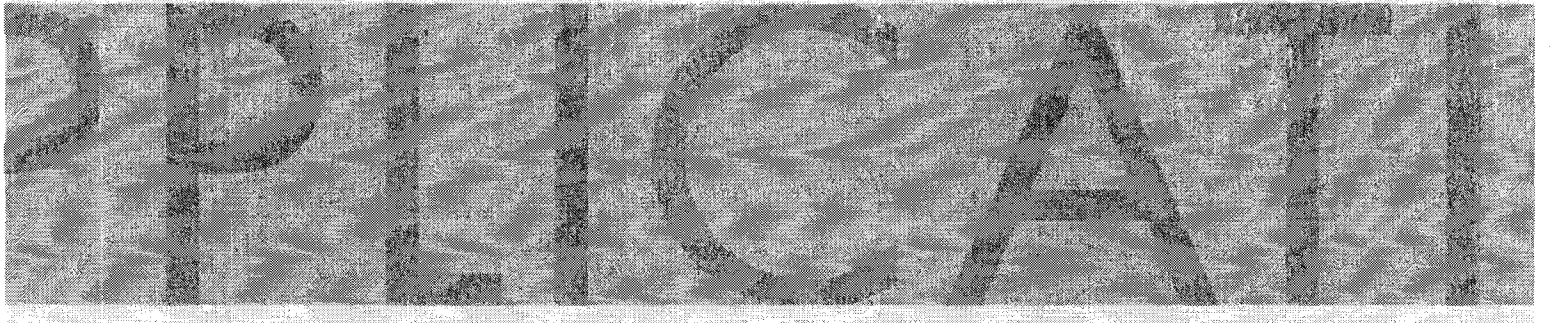
APPLICATION NOTE

beDeliverable



ARCHITECTS OF AN INTERNET WORLD

ALCATEL

Introduction

For broadband entertainment services to be successful, they must ensure delivery of the broadest range of high-bandwidth services to the maximum number of subscribers, efficiently and cost-effectively.

Network access providers (NAPs) must develop ways to increase network coverage and service bandwidth in the access network. At the same time, they must implement technologies in the edge network that will ensure smooth delivery of broadband content to each individual end user.

With a beDeliverable network, NAPs can economically evolve their networks to feed the market's growing demand for broadband entertainment services. And all players in the service delivery chain can reap the rewards of the broadband entertainment services opportunity.

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Delivery in a New Framework

New Market, New Value Chains

Broadband entertainment services provide a huge business opportunity — the chance to reach the complete market of residential digital subscriber line (DSL) consumers. And with this opportunity comes the challenge of merging two separate markets — the telecommunications market and the media market. Each has its own market players and value chains, and all the players must find a place in the new broadband entertainment services value chain.

Each player must bring added value to the services delivery process. And each must receive a fair share of the overall revenue for the value they bring. The different companies will be best placed to determine the areas in which they want to be active, and they will not be confined to a restricted set of added value. However, as shown in Figure 1, there are some natural breakdowns of skills and added values in the delivery chain.

The Broadband Entertainment Ready Framework

To meet the needs of the players in the services delivery chain, Alcatel has launched the broadband entertainment ready framework, a set of five key business and network enablers. These enablers are:

> Quality
> Openness
> Delivery
> Security
> Profitability

Figure 1 - Players in End-to-End Broadband Entertainment Service Delivery

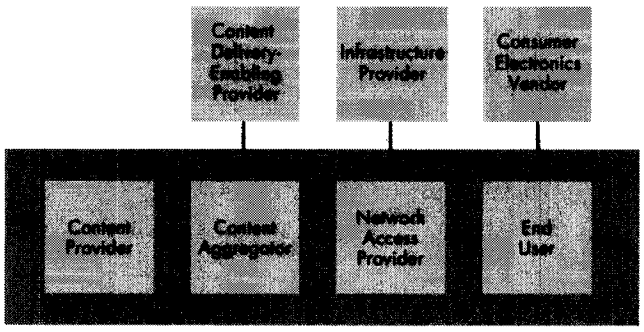


Figure 2 shows these enablers as five pillars.

With these pillars in place, all players in the service delivery chain can develop a sustainable business model to reap the rewards of broadband entertainment services.

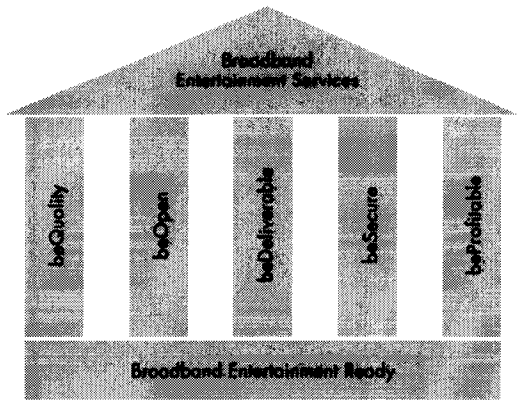
The Importance of Delivery

For DSL network access providers (NAPs) faced with declining voice revenues, broadband services offer an enormous opportunity — but only if the opportunity is managed correctly. A large part of this management entails ensuring the delivery of the broadest range of high bandwidth services to the maximum number of subscribers by the most efficient and economically sound means possible.

This application note explains how NAPs can "beDeliverable" by economically evolving their networks to feed the market's growing demand for broadband entertainment services. It also presents Alcatel's innovative approach to scalable and cost-effective delivery.

With Alcatel's broad range of products and solutions and established reputation for delivery of carrier-class networks for virtually any application, NAPs can reap the rewards of the broadband entertainment services opportunity.

Figure 2 - The Five Key Broadband Entertainment Ready Enablers



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The newest big revenue opportunity is residential broadband entertainment services, which will allow NAPs to reach the mass market of residential DSL consumers. The signs are clear that consumers in the residential segment are interested in multimedia entertainment and communication services and are willing to pay for them.

The ability to deliver these high-value services will depend on the network operator's ability to address the requirements for increased coverage of DSL Internet service and increased bandwidth in order to provide the additional services. It is imperative that the network evolution can occur in a way that focuses on profitability and business success.

Alcatel, the world leader in broadband access, is uniquely positioned to provide the broadest array of broadband access products and technologies that support the delivery of bandwidth-hungry residential broadband entertainment services to all users. Alcatel offers networking solutions to support a range of deployment options so each NAP can find the most economically beneficial way for their networks to evolve.

The Alcatel approach involves a future-safe platform that supports the technologies that can provide the coverage and bandwidth to support residential broadband entertainment services. For example, Reach Extended ADSL2 (READSL2) and remote unit solutions increase coverage. ADSL2plus, very long-reach DSL (VDSL) and fiber to the user (FTTU) increase bandwidth for all residential end users.

The multicast features in the Alcatel 7300 Advanced Services Access Manager (ASAM), Alcatel 7301 ASAM and Alcatel OmniSwitch 7700/7800/8800 provide cost-effective broadcast services.

Alcatel's evolution strategy involves introducing Ethernet, multiprotocol label switching (MPLS) and IP technology in the broadband access and edge network to decrease the cost of ownership while leveraging installed ATM networks.

Challenges

Operators will have to meet several challenges when upgrading the broadband access and edge network to become broadband entertainment ready in a cost-effective way.

Service Evolution

The primary service driver to date has been high-speed Internet (HSI) access for such applications as web browsing, chat, e-mail, data downloading and, in recent years, a surge in point-to-point applications with MP3 and video file exchanges. These services have been accommodated with ease by the current ADSL. New enriched content applications and streaming services can be anticipated to further exploit the bandwidth of ADSL and to initiate the need for higher bandwidth platforms.

Content and Devices

In addition to the enriched content made available through HSI access, the consumer electronics and entertainment industry has moved into the development of new devices (e.g., for video, gaming, image uploading, and streaming music and video) that will enable non-PC users to use networked services.

Profitability and Return on Investment

Experience has shown that, to be successful, a solution must not only be technically brilliant, but also make good business sense. It must:

> Have a relatively low initial first cost (IFC)
> Balance investments with revenue growth

To achieve profitability it will be necessary to leverage investment through evolvable platforms. Deployed platforms must leverage the existing network (copper, digital loop carriers [DLCs] and cross-connects) and must be positioned to evolve to the next step with minimum investment.

Infrastructure must be deployed rapidly to provide maximum coverage initially with a migration plan to improve bandwidth over time. Services should also be delivered in a way that is agnostic to the underlying technology.

Efforts must be made to provide new billable services on the existing infrastructure. In addition to the new value-added broadband entertainment services, this could include tiered increases in bandwidth, or enhanced business services to

teleworkers, the small office home office (SOHO) and small-to-medium enterprises (SMEs). The DSL service provider could accomplish this independently, or partnerships or a federated model could be investigated.

Technical solutions that meet the coverage and bandwidth challenges while fulfilling the business imperatives are bound to be successful.

Background

DSL deployment has been driven by the need to deliver basic HSI service to the largest population possible. Operators have succeeded by focusing the deployment of DSL infrastructure in the central office (CO), where mass coverage could be achieved at the lowest cost.

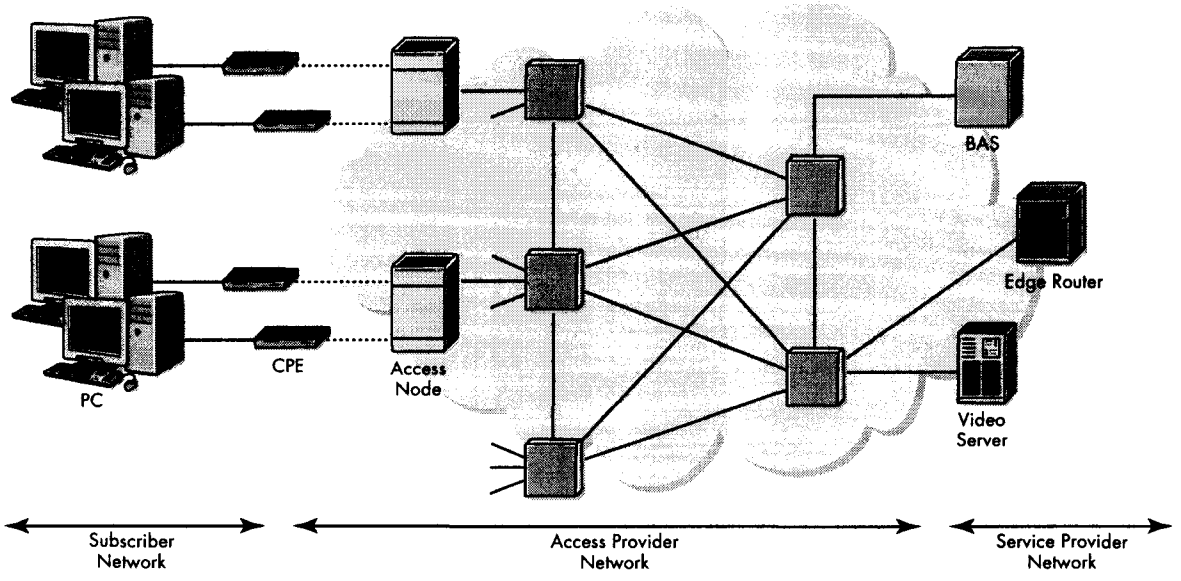
Figure 3 depicts a typical access/edge network architecture. A split is made between the access provider and the service providers. Customers require connectivity to a single or limited number of centralized points in the access network. These network elements (e.g., a broadband access server [BAS], an edge router or a video server) offer the services. This many-to-one relationship is called aggregation.

For DSL HSI access, asynchronous transfer mode (ATM) has been widely adopted as the preferred technique for aggregation. Historically, ATM was the only cost-effective statistical multiplexing technique that could be run over the main SONET/SDH architectures, transporting ATM cells between the many DSL access multiplexers (DSLAMs) and the centralized BASs. Now, packet-based transmission technologies (such as Gigabit Ethernet, possibly combined with MPLS), are finding their way into access and edge broadband networks.

The opportunity to offer new broadband services to the end user places important requirements on the access network. Issues such as scalability with respect to the number of customers, quality of service (QoS), protection, and operations and maintenance (OAM) need to be carefully addressed. ATM provides a solid solution that meets these requirements.

Ethernet-based packet-centric metropolitan networks are also being deployed. Their success lies in their high-performance packet-switching solutions based on low-cost technologies such as Gigabit Ethernet. Because of these benefits, packet-centric network technologies are finding their way toward the access network, where they are used as an aggregation

Figure 3 - A Typical Access/Edge Network Architecture



technology, while the local loop technology connecting the customer premises equipment (CPE) to the access multiplexer remains ATM/DSL-based.

Ethernet technology, however, suffers from several drawbacks. Ethernet as an aggregation technology has scalability problems. Ethernet also does not provide the same QoS awareness and support as ATM, and Ethernet protection speeds (via Fast Spanning Tree protocol) might not be fast enough. Finally, OAM features in Ethernet are poor.

Both ATM and Ethernet networks have their inherent advantages and drawbacks. The key is to use the technology that is best suited for the particular service requirements of an application. A NAP can choose whether to distribute broadcast or unicast content over the existing HSI edge network or run it over a separate overlay network. ATM can guarantee total QoS while Ethernet can deliver high-performance packet switching at low cost. Mission-critical and high-revenue applications can be transmitted over ATM (typically unicast services such as streaming video on demand [VoD] and online gaming) while less demanding, low-revenue applications can be transported over an Ethernet backbone (typically broadcast or non-QoS-aware services such as broadcast TV and Internet access).

Operators require a smooth migration path from their existing infrastructure toward this new technology. Therefore, MPLS can be introduced.

Until now, MPLS has been used mainly as a technology to cope with growth in the core of the Internet. Analogous to ATM virtual paths and virtual circuits, MPLS is connection-oriented by means of label switched paths (LSPs). As a consequence, customer traffic aggregation and segregation is a given — each customer can be uniquely identified throughout the network, based on MPLS labels. Because label stacking can be performed up to an arbitrary depth, multilevel aggregation can be achieved and scalability in terms of the number of customers is under control. MPLS is a multiprotocol tunnelling technique. As such, it can be used to transport any type of protocol, both IP and non-IP, making it a fully transparent solution. MPLS also has inherent support for class of service (CoS) and QoS.

Solutions for the Access Network

Technology Alternatives

A number of technologies can be considered for use in the evolution of the access network. The Alcatel approach to delivering residential broadband entertainment services involves a future-safe platform, which supports the technologies that can provide the required coverage and bandwidth. READSL2 and remote unit solutions increase coverage. ADSL2plus, VDSL, and FTTU increase bandwidth for all residential end users.

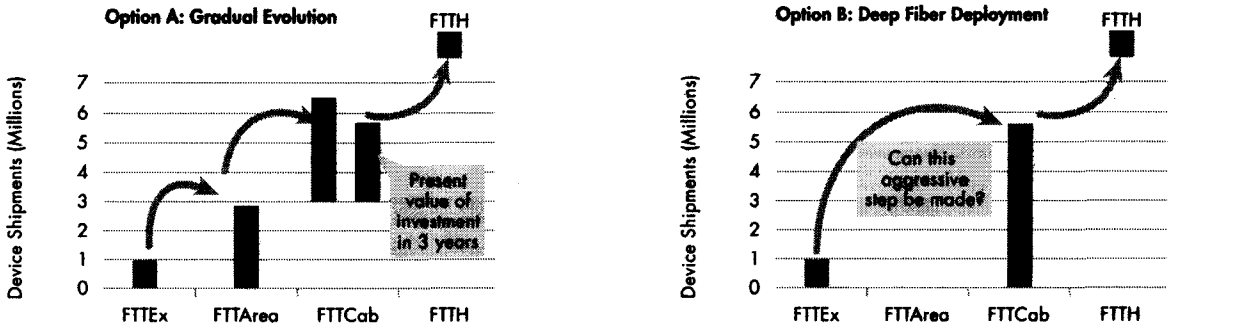
ADSL: ADSL is a well-known technology used primarily in the CO today. It can provide 1 Mb/s of connectivity over nearly 5 km (3.1 mi.) and it can provide a moderate 5.5 Mb/s over a reach of 3 km (1.86 mi.). This makes it an excellent technology for mass deployment. It can be deployed at remote DLCs in a spectrally friendly way as long as there are no copper pairs carrying DSL from the CO at the same time. It can also be used in remote DSLAMs in areas where there is no coverage possible from the CO.

READSL2: There has been work in the past year to standardize a variant of ADSL that can reach a portion of customers, who are currently unserved, and provide them with a minimum bit rate of 192/128 kb/s in addition to POTS service on loops of up to 5.5 km (3.4 mi.) long.

ADSL2plus: ADSL2plus is another variant of ADSL that is close to being standardized. It offers a significant improvement in bandwidth up to 7.5 to 10 Mb/s in the range of 1.5 to 3 km (.9 to 1.9 mi.). The performance for longer distances is equivalent to ADSL. ADSL2plus can be a means of increasing the bandwidth in all areas (whether from the CO or from remote areas) at a moderate cost.

VDSL: VDSL can be used anywhere in the outside plant along cables fed with ADSL from the CO. Both cell and packet variants of VDSL are being defined in standards. The advantage of VDSL is its higher bandwidth (5 to 22 Mb/s) and the possibility of greater symmetry. The disadvantage is the short reach — in the order of 1 to 1.5 km (.62 to .93 mi.) This implies that VDSL nodes must be deployed deep in the network with a smaller number of customers per node. That translates into higher deployment costs for both cell and packet flavors of VDSL. There will still be market segments where VDSL can

Figure 4 - Example of Evolution Pathways



be justified early on, (e.g., in multiple dwelling units [MDUs] where deployment costs are lower) or targeted areas where a high uptake of high revenue services can be anticipated.

FTTH: A variety of technologies could be considered for fiber to the home (FTTH). Point-to-point fiber from the CO requires a tremendous amount of fiber between the CO and the home. An outside plant active-star FTTH architecture suffers from both the cost of laying fiber and the ongoing expense of maintaining outside plant active electronics. Passive optical network (PON) technologies provide the advantage of fiber aggregation in an entirely passive mode, and thus offer the optimal life cycle costs for FTTH.

These technologies can be deployed in the network in different ways, some of which are summarized in Table 1.

Evolution Pathways

The deployment approaches described in Table 1 can be rolled into a multistep evolution plan. For example, one option could be to take a single large step to fiber to the cabinet. An alternative would be to evolve in two steps, first to FTTArea and then to FTTCab. Figure 4 illustrates a sample deployment strategy.

Evolution pathways for mass deployment

Option A, illustrated in Figure 4, allows coverage and bandwidth to be increased to the mass market while achieving the

Table 1 - Deployment Alternatives

FTTExchange	Deploy in the CO	Lowest cost approach in all cases (ADSL, ADSL2plus, READSL2 and VDSL). The cost of deployment is simply the cost of a new line card.
FTTArea	Fiber is rolled out to a remote node at a central location serving multiple feeder/ distribution interface (FDI) cabinets	DSL equipment can be centralized rather than deployed at every FDI.
FTTArea at DLCs	Deploy ADSL beyond the reach of the CO or in areas within the exclusive coverage of a DLC	The most cost-effective approach for serving outlying areas with lower density housing than the areas near the CO. These areas lend themselves well to the long reach nature of ADSL and ADSL2plus.
FTTBuilding	Deploy fiber to the multiple dwelling unit (MDU)	This is where the greatest deployment has taken place. The driver has not been pure video but other applications including gaming.
FTTH	Deploy fiber to the individual home user	Generally cost-prohibitive, except in greenfield areas where a major investment is already required for voice, or in an all-aerial distribution network, or where municipality, community groups, real estate or utility investment will help defray the cost.

necessary business imperatives. The relatively light deployment allows for a low initial first cost, rapid deployment, speed to market a, broad addressable market and the creation of new revenue at relatively low risk. The subsequent evolution to FTTCab can be done with lower risk if, when and where there is demand and a way that leverages almost 100 percent of the previous investment.

Evolution pathways for targeted deployment

There are areas where the higher cost of deployment can be justified in order to obtain the higher bandwidth. Some examples include large MDUs, where many customers can be signed on at once; in a CO with extremely high density; or in areas with high concentrations of business customers with a greater willingness to pay for increased upstream bandwidth.

Tailored deployment for specific requirements

There will be multiple pathways chosen to evolve the access network. Some operators will choose an aggressive deployment due to financial conditions and business drivers while others will take a more gradual evolutionary approach.

Multiple access platforms

The result will be the emergence of multiple access platforms in different areas, as depicted in Figure 5.

Alcatel understands that, with such a variety of access technologies, it will be important to provide seamless ubiquitous services in a technologically agnostic manner to all customers, regardless of their access platform.

Figure 5 - Multiple Access Platforms